Zoom Lens (Fig. 34.44a)

\[ f_1 = 12\text{cm} \quad f_2 = -12\text{cm} \]

(a) Where is image of converging lens?

\[ s_i = \infty \quad \Rightarrow \quad \frac{1}{s_i} + \frac{1}{s_i'} = \frac{1}{f} \quad \Rightarrow \quad s_i' = f_i = +12.0\text{cm} \]

(to right of lens 1)

(b) What is object distance for lens 2?

See fig above - lenses 4 cm apart so image 1 is 8 cm to right of lens 2. The 2nd object 2 but object now on side of incoming light so magnitude must be \(-8\text{cm}\).

\[ s_2 = -8\text{cm} \]

(c) Where is final image?

\[ \frac{1}{s_2} + \frac{1}{s_2'} = \frac{1}{f} \quad \Rightarrow \quad -8\text{cm} + \frac{1}{s_2'} = \frac{1}{-12\text{cm}} \]

\[ s_2' = \frac{1}{\frac{-12\text{cm}}{8\text{cm}}} = +24.0\text{cm} \]

(on outgoing light side so 24 cm to right of lens 2)

(d) What if lenses 8 cm apart?

(a) Same \[ s_i' = 12\text{cm} \] since \( s_1 \to \infty \) still

(b) \[ s_2 = -4\text{cm} \]

\[ \frac{1}{s_2} + \frac{1}{s_2'} = \frac{1}{f} \quad \Rightarrow \quad -4\text{cm} + \frac{1}{s_2'} = \frac{1}{-12\text{cm}} \]

\[ s_2' = 6.0\text{cm} \]